DIE-CASTING APPARATUS FOR A VERTICAL PRESS

BACKGROUND OF THE INVENTION

This invention relates to a die casting apparatus for a vertical press, and more precisely the invention concerns an apparatus for die-casting electric rotors of cage type for small and medium sized motors.

Small and medium-sized motors are understood to mean motors having rotors of a diameter ranging between 25 and 200 mm.

STATE OF THE ART

Small and medium-sized electric motors are widely used in several fields, for example in the automotive field to operate the various servomechanisms.

In view of the large-scale consumption and the need to reduce or limit the production costs to a minimum, the present tendency is to use horizontal presses with a multidie assembly or provided with several independent dies.

Each die is axially aligned with a corresponding die on an oppposite side in order to clamp one or more stacks of steel laminations defining the body of a rotor.

Each die is provided with one or more annular grooves which communicate with corresponding annular grooves in the other die, through longitudinal slots or holes in the stack of the rotor laminations, into which a molten metal is

injected, for example an aluminium alloy, to form the short circuiting rings and the longitudinal bars of a cage for the circulation of the electric currents.

Horizontal multidie presses allow high outputs with relatively short cycle times, and at costs considered commercially acceptable.

For example, presses having dies with 12 to 14-cavities, for the production of 25-35 mm diameter rotors, allow operative cycles of 35-40 seconds, corresponding to an output of one rotor every 2.5 - 3.3 seconds.

However, a horizontal press presents a number of limits and drawbacks, such as excessive overall dimensions, the presence of heavy moulds which create difficulties during their replacement, high investment costs, and maintenance difficulties.

In addition, high forces of about 300-600 tons are usually required for clamping the moulds in a vertical press.

Single-station vertical die casting presses are also known, for example from US 4,088,178 and US 4,799,534; said presses have a less cumbersome structure compared to the horizontal presses, and require less pressure and force to clamp the moulds.

Usually, these type of presses comprise a tiltable or

horizontally movable injection unit, consisting of an injection sleeve for containing the molten metal, and a plunger or piston member for injecting the molten metal into the shaping cavities of the dies; this type of press, however, has the disadvantage of low productivity, with comparatively high cycle times, in particular in casting small and medium diameter rotors.

In order to partly obviate this drawback , US 3,315,315 and US 3,866,666, suggest the use of a vertical press provided with a rotary table for supporting a plurality of die member and a single injection unit; although with this type of presses it is possible to achieve a moderate automation degree, their operative cycle still proves to be comparatively high, with poor output capacities compared to the horizontal presses.

US 5,660,223, which represents the closest prior art, relates to a vertical die-casting press comprising a frame, one rotary table for supporting a plurality of injection units, and a stationary bottom die member positioned above the table, which is aligned with an upper die member to clamp a stack of metal laminations to be injected with a molten metal.

The bottom die member, together with the upper one provide a die-casting mold, which is urged, from the top,

against a metal distributor or gate plate, and against an injection unit which from time to time comes to rest in a metal transfer station of the press; indexing control means are provided for controlling the movement of the rotary table for moving each injection unit between a workstation for receiving the molten metal and a metal transfer station for the injection into the die mold.

As stated in the same document, the partially salified injection residue or biscuit in the sprue foles of the gate plate, which remain attached to the undercut dovetail slots at the upper side of the plunger, is separated by a downward movement of the plunger into the injection sleeve.

When the table is indexed to rotate, the injection unit with the biscuit is transferred to the metal receiving station, where the biscuit must firstly be removed by a pushing device, before a new charge of molten metal be poured into the sleeve.

A press of this kind, however, still does not offer a significant reduction in the molding cycle times, in that part of the operations necessary for die-casting the rotors, in particular the cleaning operations for the dies, the loading of the metal laminations, the injection of the molten metal, the casting of the rotors, and separation of the biscuit, are carried out at subsequent times in the same

metal transfer stations, with a consequent increasing of the casting cycle times.

Moreover, all the die clamping forces are transmitted directly onto the rotational axis of the supporting table, thereby causing high stresses on the same table and rotational axis due to the bending moment which in time can lead to the deformation or malfunctioning of the press.

There is consequently a need to further improve this type of press, in such a way as to achieve particularly short cycle times for casting, compared to the known vertical presses, and comparatively equivalent to or shorter than those of the horizontal presses, in particular as far as the production of small and medium-sized rotors is concerned.

Moreover, there is a need to provide a vertical die-casting press having high ergonomic characteristics, in order to facilitate the work of the operators during the casting and during the maintenance operations of the press.

OBJECTS OF THE INVENTION

The main object of this invention is to provide a die-casting apparatus for a vertical press, in particular for the die-casting of electric rotors of cage type, whereby it is possible to achieve a considerable reduction of the die-casting cycle compared to the known vertical presses, and to

achieve extremely limited cycle times, comparatively similar to or shorter than those of the horizontal presses.

A further object of this invention is to provide an apparatus for the die-casting of electric rotors, having high ergonomic characteristics, so as to facilitate its use and maintenance by an operator.

BRIEF DESCRIPTION OF THE INVENTION

A main feature of this invention concerns a die-casting apparatus of a vertical-press for die-casting of electric rotors, comprising a rotary table for supporting a plurality of lower die members angularly spaced apart from one another, and a rotary table for supporting a corresponding plurality of metal injection units, in which the injection units are axially movable with respect to the supporting table and in which one of the rotary tables is arranged and positioned to partially overlap the other one, to selectively and sequentially aligne each die member with a corresponding injection unit, in a metal injection station, and to sequentially move the die members and the injection units in different working stations of the press.

Each injection unit is axially alignable with a corresponding bottom die member, and with an upper die member in correspondence with a central injecting or metal transfer station under the control of indexing means to move

the two tables step by step in synchronism.

In particular, each injection unit is movably supported in the axial direction with respect to the respective table, between a lowered position and a raised position in which it is tightly urged against a lower die member.

Even though with this solution it is possible to considerably improve the productivity in respect of conventional vertical presses, rendering them competitive compared to horizontal presses for casting rotors of diameter equivalent to or higher than 200/250 mm, there remains the further problem of rendering this type of press particularly suitable for moulding small and medium-sized rotors, for example having a diameter ranging from 25 to 200 mm, and at the same time making such press competitive with horizontal presses in terms of productivity.

According to the invention, this problem have been solved by providing a die-casting apparatus for a vertical press, the apparatus comprising:

a first rotary table for supporting a plurality of metal injection units;

a second rotary table for supporting a plurality of bottom die members;

said first and second rotary tables being partially overlapped and arranged to allow, upon their indexed

rotation, a superimposition of each die member with a respective injection unit, and their alignment with an upper die member in a metal injecting station of the press;

first and second indexing means being provided to sequentially rotate the first and second tables to bring each bottom die member and each injection unit around a number of respective workstations comprising said metal injection station of the press;

each of said bottom die members and each of said injection units being movably supported from a lower disengaged position, and an upper position in which both the injection unit and the bottom die member are engaged and urged upwards against a a stack of laminations of a rotor in their aligned position with the metal injection station of the press.

BRIEF DESCRIPTION OF THE DRAWINGS

These and further features according to this invention, will be more clearly evident from the following description with reference to the accompanying drawings, in which:

- Fig. 1 shows a front view of a vertical press provided with an apparatus for the die-casting of cage-type electric rotors, according to the invention;

- Fig. 2 shows an enlarged detail of Fig. 1, with the injection plunger in an advanced position;

- Fig. 3 shows the same detail of Fig. 2, with the sleeve of the injection unit in a rised position against the bottom die member, and the biscuit inside the sleeve;

- Fig. 4 shows the same detail of Fig. 2, with the injection unit in a lowered position;

- Fig. 5 shows an injection unit in correspondence with a station for removal of the biscuit;

- Fig. 6 shows another enlarged detail of Fig. 1, showing rotor clamped between the upper and the bottom die member, and the rotor demolding device;

- Fig. 7 shows an enlarged detail of Fig. 6;

- Fig. 8 shows another enlarged detail of Fig. 6;

- Fig. 9 is a cross-sectional view of a bottom die casting member;

- Fig. 10 is a top view of the rotary tables for supporting and moving the bottom die members and the injection units around respective workstations of the press;

- Fig. 11 shows a control diagram for the die casting apparatus of Fig. 1.

DETAILED DESCRIPTION OF THE INVENTION

The general features of the invention will be illustrated hereunder by means of a preferential embodiment.

As shown in figure 1, a vertical-press provided with a die-casting apparatus for molding the cages of electric rotors, comprises a frame 10, for supporting a first rotary table 11, and respectively a second rotary table 12, arranged to rotate according to a respective vertical axis; the second table 12 is arranged in a position partially overlapping the first rotary table 11. The second table 12 supports a plurality of bottom die members 14, while the first table 11 supports a corresponding plurality of injection units 13, to be sequentially brought around a corresponding number of workstations as explained further on.

Each injection unit 13 is axially movable with respect to the table 11 between a lowered position and a raised position against a bottom die member 14 in correspondence with a central injection or metal transfer station shown in figures 1 and 2.

An electric rotor of the cage type usually comprises a stack of metal laminations P and a metal cage for circulation of the current; the cage includes a plurality of bars which extend longitudinally in slots of the stacked lamination between short-circuiting rings at their ends.

Each table 11 and 12 is made to rotate step by step in synchronism by means of respective motor-powered indexed

control means 15 and 16, so as to sequentially make each injection unit 13 move and stop in an axially aligned disposition with a corresponding bottom die member 14, and an upper die casting member 17 in correspondence with the metal transfer station for injecting the molten metal into the die members and a stack of laminations clamped between them.

In order to reduce the stresses on the upper rotary table 12, the bottom die member 14 are movably supported by the same table 12, so as to allow a short vertical movement for tightly clamping the laminations P against the upper die member 17.

This is made possible, as shown in figures 12 and 9, by providing each bottom die member 14 with an annular flange 63 which, upon a short vertical movement, rests against a bottom shoulder 64 of a seating in the rotary table 12. The annular flange 63 is smaller in thickness than the height of the seating, so as to have a small gap 65 in its lowered condition, see figures 4 and 9, compared to a upper stop ring 66 to allow the aforesaid vertical movement.

The same upper die member 17 is supported for raising and lowering movements by a control unit 18, in turn connected to the frame 10 of the press.

The rotary tables 11 and 12 are preferably in the form of a Maltese cross, as shown in figure 10, having four diametrically opposite arms to support a corresponding number of injection units 13, and respectively of die members 14.

In the example shown, the lower rotary table 11 is conformed to support four injection units 13, angularly spaced apart by 90°, each comprising an injection sleeve 19 for containing a metered quantity of a molten metal, and a plunger 20 axially movable within the sleeve 19.

Correspondingly, the upper rotary table 17 supports four bottom die members 14, angularly spaced apart by 90°.

Each injection sleeve 19, in the metal injecting station, may be moved between a raised position, shown in figure 2, in which it is urged against a bottom die member 14 of the rotary table 12, and a lower position, shown in figure 4, in which the sleeve 19 is slightly spaced apart from the overlying table 12.

The sleeve 19 is axially guided in its vertical movement by a guide bush 21 which extends from the rotary table 11.

A plurality of rods 22, for example four, in correspondence with the corners of a square, extend downwards from the sleeve 19; the rods 22 have their ends

connected to a square-shaped flange 23, designed to engage during the rotation of the lower table 11, with a stationary gripping member 24. The gripping member 24 is in the form of a fork member compring two brackets 25 secured to the upper side of a supporting bush 26; the bush 26 is connected to a first control means through a supporting plate 27 which extends laterally to the supporting bush 26.

The first control means comprises for example two hydraulic cylinders 28′ and 28′′ parallelly arranged and symmetrically disposed with respect to the vertical axis of the press, in a position beneath the plate 27; the hydraulic cylinders 28′, 28′′ connect the frame 10 of the press with the side ends of the supporting plate 27.

Within each injection sleeve 19 slides a thrust plunger 20 having a rod 20′ connected by a neck portion 29′ to a widened head 29; the neck portion 29′ and the head 29 in turn engage, during the indexed rotation of the table 11, with a movable gripping member 30 connected to a second control means.

The upper end of the plunger 20 is provided with gripping means for gripping the biscuit of the residual metal which forms into the prue holes 14′ of lack die member 14, due to solidification of the molten metal previously injected.

Preferably, the gripping means for the biscuit comprise at least one laterally extending and tapering dovetail slot 20'' at the front face of the plunger 20, having a diverging or converging radial profile.

As shown in figures 1 and 2 the movable gripping member 30 is secured to the upper end of a rod 31 of second control means, such as a hydraulic control cylinder 32 fastened beneath the plate 27 in a central position between the two side cylinders 28', 28'' of the first control means.

The cilinders 28', 28'' are positioned laterally and at the same height as the second control means 32 for the injection units 13, thereby improving the ergonomics of the moulding apparatus, in that a consistent reduction is achieved in the overall height dimension of the apparatus, as well as a low disposition of the rotary tables 11 and 12, thus facilitating the work of the operators.

As shown in figure 6, the raising and lowering unit 18 for the upper die member 17 is provided with a bush 33 for housing the stack P of laminations of the electric rotor; the bush 33 with the upper die member 17 and the bottom die member 14, together define a die-casting mould.

Each bottom die member 14, and the upper die member 17 may comprise one or more annular cavities for moulding a corresponding number of rotors; in particular, for rotors of

small dimensions, for example 30 mm, it is possible to provide up to four cavities for each lower die member 14, while for rotors of larger dimensions, for example 60 mm, only one cavity is possible.

The raising and lowering unit 18, as shown in figures 6, 7 and 8, comprises a cylindrical sliding member 34 for supporting the housing bush 33; the sliding member 33 is vertically movable along a guide hole in an upper crosspiece 10′ of the supporting frame 10.

The sliding member 34 is in turn operatively connected to means for removing the rotor from the housing bush 33, upon completition of an injection step and solidification; the rotor removing means comprise first linear actuator, such as a hydraulic cylinder 35 having a hollow piston 36 and a hollow piston rod 37, the latter being connected to the upper die member 17 of the die-casting mold.

The cylinder 35, which supports the sliding member 34 and the housing bush 33 is connected by a cross bar 38 to two hydraulic cylinders 39′, 39′′, upwardly extending from the upper crosspiece 10′ of the frame 10.

The tubular piston rod 37 constitutes the guide for means for detaching a rotor from the upper die member 17, at the demolding; said rotor detaching means comprise a bar 41 which extends coaxially to the cylinder 35; the bar 41 is

connected at the upper end with a piston 40 of a single-acting cylinder. A pushing element 42, for example in the form of an upturned bowl-shaped element, is provided at the lower end of the bar 41 to push down the stack of magnetic laminations P of the rotor, detaching the same from the die member 17.

Side locking devices 43 are provided for locking the sliding member 34, and consequently the housing bush 33, when it is tightened against a bottom die member 14 during the injection of the molten metal.

The die-casting apparatus also comprises means for supporting the edge of the rotary table 12, in the injection or metal transfer station, so as to counteract any resistance that the stack of magnetic laminations may develop during the insertion into the housing bush 33, as well as the weight of the movable components of the raising unit 18 during the ejection of a rotor from said housing bush 33; the supporting means, as shown in figure 6, are for example in the form of a vertical arm 44 connected to the crosspiece 10′ of the frame 10, the lower end of which is provided with a fork-shaped element 45 facing towards the edge of the table 11, so as to engage and support the same.

The apparatus also comprises means for the forced circulation of a cooling fluid, for cooling the bottom dies

14, to allow a more efficient dispersion of the heat, thereby achieving the rapid solidification of the molten metal. As shown in figure 9, each bottom die member 14 is provided with a channel 46 for the circulation of a cooling fluid fed by a pressurised fluid source 47, through a rotary coupling, not shown; this allow the solidification of the biscuit to be accelerated enabling it to be detached and removed from the bottom die 14 as far in advance as possible.

In order to facilitate the cooling of the rotor, the housing bush 33 is also provided with channels for the circulation of a fluid, not shown, capable of affecting its temperature, without however lowering it excessively, so as not to jeopardise the metallurgical characteristics.

The die-casting apparatus described above brings about a considerable reduction in cycle times, and a consequent increase in output, thanks to a working procedure specially designed to exploit the features of the apparatus itself.

In particular, the four injection units 13 supported by the rotary table 12 can be moved in sequence to the workstations A1, A2, A3 and A4, figure 10, in which the following operations may be carried out simultaneously:

A1 - in this workstation the sleeve 19 is fed with a metered quantity of molten metal, taking it from a melting furnace, not shown, disposed next to the casting apparatus;

A2 - in this workstation, by exploiting the rotation of table 12, first of all each sleeve 19 and the plunger 20 are operatively connected to their respective hydraulic control cylinders 28′, 28′′ and 32, when they come into line with the raising unit 18 of the upper die member 17 in the metal injecting station. In A2 the sleeve 19 is raised against a bottom die member 14 in a overlying position, urging the same die member 14 upward against the stack P of laminations and the upper die member. The molten metal is consequently transferred inside the mould by raising the plunger 20, injecting the metal through the sprue holes 14′ into the bottom die 14, the pack of laminations P and into the upper die member 14; lastly, after a pre-established cooling time has elapsed, the plunger 20 and the injection sleeve 19 are lowered, according to a precise procedure illustrated further on, to cause the detachment of the biscuit 48 in the sprue holes 14′ of the bottom die 14, and respectively to disengage the sleeve 19 from the same bottom die 14;

A3 - In this station the biscuit 48 is removed from the plunger 20 and discharged onto a chute 49 by means of a thrust member 50 operated by its own hydraulic cylinder 50′,

shown in figure 5 turned over sideways for illustrative purposes;

A4 - each injection sleeve 19 in this station is cleaned and lubricated, before returning it to the metal receiving station A1.

Correspondingly, the bottom die members 14 supported by the rotary table 12 can be moved in sequence to the various workstations B1, B2, B3 and B4, in which the following operations are carried out simultaneously:

B1- a die 14 is loaded with a stack of magnetic laminations P, taking it from a conveyor 51 by means of a rotary arm 52 of a manipulator;

B2 - in this workstation, a stack of magnetic laminations P previously loaded, is enclosed by the housing bush 33, by operating the unit 18 which supports the bush 33 and the upper die member 17, so as to form, together with the bottom die member 14, an injection mould for the molten metal;

B3 - in this workstation, after having removed a rotor R from a bottom die member 14 by means of an appropriate expulsion cylinder 62, figure 11, the rotors R are picked up by a rotary arm 53 in figure 10, and transferred onto a conveyor 54 on a side of the apparatus opposite to that of

the conveyor 51 for feeding the stacks of magnetic laminations P;

B4 - the bottom die 14 undergo a final cleaning and lubrication step after the molded rotors R have been discharged.

According to the invention, the reduction in the casting cycle times is primarily achieved during the detachment and removal steps of the biscuit 48; in particular, in correspondence with the injection metal station A2, B2, once the molten metal has been injected into the slots of the stack P and into the cavities of the casting dies 14,17, it is made to cool rapidly thereby affecting the temperature of the bottom die member 14 by the forced circulation of a cooling fluid through the channel 46 inside the die 14; this gives rise to a prompt shrinkage of the metal thereby facilitating the subsequent removal of the biscuit 48 from the bottom die 14.

In order to facilitate the movement of the plunger 20 inside the sleeve 19, their temperature is also affected by means of a cooling fluid which is made to circulate through appropriate channels, not shown.

Subsequently, the plunger 20 is firstly made to move back, as shown in figure 3, by operating the hydraulic cylinder 32, so as to cause the rupture of the biscuit 48

from the short circuit ring of the rotor R, then the backward movement of the plunger 20 is continued to remove the biscuit 48 from the bottom die member 14 and draw the same inside of the injection sleeve 19.

The injection sleeve 19 is also lowered, as shown in figure 4, by operating the hydraulic cylinders 28′ and 28′′, so as to disengage it from the bottom die 14, thereby enabling the rotation of the tables 11 and 12. The aforesaid lowering of the injection sleeve 19 can be carried out either simultaneously or subsequently to the withdrawal of the plunger 20, and is in the range of a few millimetres, preferably between 1 and 10 mm, consequently allowing a rapid movement of the injection sleeve 19.

In this way, it is then possible to rotate the table 12 so as to move the injection unit 13 from the workstation A2 to the workstation A3, for removal and discharge of the biscuit 48.

In correspondence with the aforesaid workstation for removal of the biscuit 48, as shown in figure 5, operative means are provided, such as an ejection cylinder 55 connected with a second or stationary gripping member 56 having two brackets 57 designed to engage the flange 23 of each injection unit 13 during the rotation of the table 12.

Likewise, the widened head 29 at the rear end of the rod of the plunger 20 in turn engages, during the rotation of the table 12, with a second or movable gripping member 58 connected to the rod of the ejection cylinder 55, which is movable between a forward position and a backward position.

Consequently, the ejection cylinder 55 can be controlled so as to raise the plunger 20 far enough to rise the biscuit 48 outside the injection sleeve 19, enabling the side thrust member 50 to remove the biscuit 48, by making it slide laterally until it is released from the dovetail gripping means 20''.

To facilitate the engagement and/or disengagement between the widened head 29 of the plunger 20 and the second or movable gripping member 58, biasing spring means 59 are provided in correspondence with its backward position, for example a helical spring, acting on said movable gripping member 58 to causes it to move forward slightly, thereby limiting dragging and consequent wear between the head 29 and the gripping member 58.

Once the molten metal has been solidified, the rotor is removed from the housing bush 33 by exerting a first downward thrust force on the rotor R, to keep it against the bottom die member enabling at the same time the bush 33 to slide freely upwards.

The short circuit ring of the rotor is subsequently detached from the upper die member 17 by exerting a second axial downward thrust on the stack of magnetic laminations P, by operating the detaching means for the rotor, causing the lowering of the piston 40 to which the pushing element 42 is connected.

The upward movement of the bush 33 is then continued by operating the hydraulic cylinders 39′ and 39′′, so as to be able to rotate the upper table 12, to shift the rotor towards the workstation B3, and carry out the discharge step.

The working steps are cyclically repeated to cast further rotors, making the table 11 supporting the injection units 13 and the table 12 supporting the bottom die members 14, to rotate step by step, or in indexed mode, in synchronism by simultaneously carrying out in each of the workstations A1, A2, A3 and A4, and in each of the workstations B1, B2, B3 and B4 the respective operations described above.

Figure 11 shows the hydraulic control diagram of the die-casting apparatus, in which each hydraulic control cylinder is controlled by a respective solenoid valve 60A-60H which receives control signals from an electronic

control unit CPU programmed to control the cyclic operation of the apparatus.

In particular, a hydraulic power unit 61 provides a pressurised fluid for the solenoid valves 60A-60H, which, according to signals received from the CPU, control the operation of the hydraulic cylinders of the apparatus.

The CPU in turn acquires indexed consent signals from the rotary tables 11 and 12, to enable it to coordinate the various movements.

The CPU, moreover, is programmed to actuate the first control means 28′ and 28′′ of the injection sleeve 19, and the second control means 32 of the plunger 20, to selectively cause the detachment of the biscuit from the rotor and its removal from the bottom die member 14 by the withdrawal of the plunger 20 into the injection sleeve 19, and to also cause the lowering of the injection sleeve 19 to disengage it from the bottom die 14.

The following two comparative tables I and II, obtained respectively from tests carried out on a vertical press according to the invention, and on a conventional horizontal press, show that the die-casting apparatus according to the invention is highly competitive compared to a conventional horizontal press.

TABLE I

Vertical press according to the invention				
Clamping force (Tons)	Rotor diameter (mm)	Number of cavities (n°)	Cycle time (sec.)	Time for each rotor (sec.)
25	25 - 35	4	9	2.25
25	40 - 45	2	9	4.5
25	45 - 70	1	9	9
35	60 - 90	1	12	12
50	75 - 120	1	15 -25	15 - 25
100	125 - 180	1	30 - 45	30 - 45

TABLE II

Conventional horizontal press				
Clamping force (tons)	Rotor diameter (mm)	Number of die cavities	Cycle time (sec.)	Time for each rotor (sec.)
300	25 - 35	12 ÷ 14	35 - 40	2.5 – 3.3
300	40 - 50	6 ÷ 8	40 - 45	5 – 7.5
400	55 - 70	6	45 - 50	7.5 – 8.3
500	60 - 90	4	45 - 55	11.25 – 13.75
600	95 - 120	2	60 - 70	30 – 35
600	125 - 180	1	70 - 100	70 – 100

From the above, it will be seen that for rotors of a same diameter, the time required by the apparatus according to the invention to cast each rotor is equivalent to that of a horizontal press for rotors of small diameter, and considerably shorter for rotors of larger dimensions.

Therefore, considering the smaller investment necessary for purchasing a vertical press according to the invention, as compared to a horizontal press, the smaller overall dimensions and greater ergonomics for the operators, a

vertical press apparatus according to the invention proves to be highly competitive both to conventional vertical presses, and to horizontal presses.

What has been described and shown with reference to the accompanying drawings has been given purely by way of example in order to illustrate the general features of the invention, as well as a preferred embodiment; consequently, other modifications and variations to the apparatus for casting electric rotors are possible, without thereby deviating from the scope of the appended claims.